

a liquid delivery device comprising:
 a communication module; and
 a rigid structure and a membrane variably defining a dispensing chamber, the dispensing chamber configured to receive liquid;
 an acoustic volume sensor including:
 an enclosed fixed chamber acoustically coupled to a speaker and a first microphone; and
 a variable chamber acoustically coupled to the fixed volume via a first port and acoustically coupled to a second microphone, the variable chamber variably defined in part by the membrane, the acoustic volume sensor configured to acoustically excite the air in the fixed chamber at a first frequency, then receive acoustic spectra from the first microphone and second microphone; and
 a processor in communication with the communication module and the acoustic volume sensor, the processor configured to receive a first acoustic spectra signal from the acoustic volume sensor, to make a comparison of the received acoustic spectra signal to a predetermined model spectra, and to detect a

bubble in the dispensing chamber when the received acoustic spectra is substantially equivalent to a predetermined model spectra of a bubble in the dispensing chamber.

18. The system to deliver therapeutic liquid of claim **17**, wherein the processor is configured to initiate a compensatory action when a bubble is detected.

19. The system to deliver therapeutic liquid of claim **17**, wherein the processor is configured to initiate an alarm at the user interface assembly when a bubble is detected.

20. The system to deliver therapeutic liquid of claim **17** wherein the user interface assembly is separate from the liquid delivery device and capable of wireless communication with the liquid delivery device.

21. The system to deliver therapeutic liquid of claim **17**, wherein the user interface assembly is integrated into at least one of a computer, a cell phone, and a consumer device.

22. The system to deliver therapeutic liquid of claim **17**, wherein the acoustic volume sensor further comprises a second port acoustically coupling the variable chamber to the second microphone.

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